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विशेष प्रकार की कुंडलण तारों की विशिष्टियाँ

भाग 0 सामान्य अपेक्षाएँ

अनुभाग 2 अनेमलित आयताकार कॉपर की तार

(पहला पुनरीक्षण)

Indian Standard

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES

PART 0 GENERAL REQUIREMENTS

Section 2 Enamelled Rectangular Copper Wire

(First Revision)

ICS 29.060.10

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2011 **Price Group 8**

Winding Wires Sectional Committee, ETD 33

NATIONAL FOREWORD

This Indian Standard (Part 0/Sec 2) (First Revision) which is identical with IEC 60317-0-2 : 2005 'Specifications for particular types of winding wires — Part 0-2: General requirements — Enamelled rectangular copper wire' issued by the International Electrotechnical Commission (IEC) after incorporating Amendment No. 1 in 1999 and Amendment No. 2 in 2005, was adopted by the Bureau of Indian Standards on the recommendation of the Winding Wires Sectional Committee and approval of the Electrotechnical Division Council.

This standard was first published in 1993. This revision has been undertaken with a view to bring it in line with the latest version of IEC 60317-0-2 : 2005.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60172 Test procedures for the determination of the temperature index of enamelled winding wires	IS 5825 : 1993 Test procedure for the determination of the temperature index of enamelled winding wires (*first revision*)	Identical
IEC 60317-16 Specifications for particular types of winding wires — Part 16: Polyester enamelled rectangular copper wire, class 155	IS 13730 (Part 16) : 1996 Specifications for particular types of winding wires: Part 16 Polyester enamelled rectangular copper wire, class 155	Identical with IEC 60317-16 : 1990
IEC 60317-17 Specifications for particular types of winding wires — Part 17: Polyvinyl acetal enamelled rectangular copper wire, class 105	IS 13730 (Part 17) : 1996 Specifications for particular types of winding wires: Part 17 Polyvinyl acetal enamelled rectangular copper wire, class 105	Identical with IEC 60371-17 : 1990
IEC 60317-28 Specifications for particular types of winding wires — Part 28: Polyesterimide enamelled rectangular copper wire, class 180	IS 13730 (Part 28) : 1997 Specifications for particular types of winding wires: Part 28 Polyesterimide enamelled rectangular copper wire, class 180	Identical with IEC 60371-28 : 1990
IEC 60317-29 Specifications for particular types of winding wires — Part 29: Polyester or polyesterimide overcoated with polyamide-imide, enamelled rectangular copper wire, class 200	IS 13730 (Part 29) : 1996 Specifications for particular types of winding wires: Part 29 Polyester or polyesterimide overcoated with polyamide-imide enamelled rectangular copper wire, class 200	Identical with IEC 60371-29 : 1990

(*Continued on third cover*)

Indian Standard

SPECIFICATIONS FOR PARTICULAR TYPES OF WINDING WIRES

PART 0 GENERAL REQUIREMENTS

Section 2 Enamelled Rectangular Copper Wire

(First Revision)

1 Scope

This International Standard specifies the general requirements of enamelled rectangular copper winding wires.

The range of nominal conductor dimensions is given in the relevant specification sheet.

When reference is made to a winding wire according to a standard of the IEC 60317 series mentioned under clause 2, the following information is given in the description:

– reference to IEC specification;

– nominal conductor dimensions in millimetres (width × thickness);

– grade.

EXAMPLE: IEC 60317-16 – 4,00 × 1,00 Grade 1

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60172, *Test procedure for the determination of the temperature index of enamelled winding wires*

IEC 60317-16, *Specifications for particular types of winding wires – Part 16: Polyester enamelled rectangular copper wire, class 155*

IEC 60317-17, *Specifications for particular types of winding wires – Part 17: Polyvinyl acetal enamelled rectangular copper wire, class 105*

IEC 60317-18, *Specifications for particular types of winding wires – Part 18: Polyvinyl acetal enamelled rectangular copper wire, class 120*

IEC 60317-28, *Specifications for particular types of winding wires – Part 28: Polyesterimide enamelled rectangular copper wire, class 180*

IEC 60317-29, *Specifications for particular types of winding wires – Part 29: Polyester or polyesterimide overcoated with polyamide-imide, enamelled rectangular copper wire, class 200*

IEC 60317-30, *Specifications for particular types of winding wires – Part 30: Polyimide enamelled rectangular copper wire, class 220*

IEC 60851 (all parts), *Methods of test for winding wires*

ISO 3, *Preferred numbers – Series of preferred numbers*

3 Definitions, general notes on tests and appearance

3.1 Definitions

class
the thermal performance of a wire expressed by the temperture index and the heat shock temperture

coating
a material which is deposited on a conductor or wire by a suitable means and then dried and/or cured

conductor
the bare metal after removal of the insulation

crack
an opening in the insulation which exposes the conductor to view at the stated magnification

dual coating
an insulation composed of two different materials, an underlying and a superimposed coating

enamelled wire
a wire coated with an insulation of cured resin

grade
the range of thickness of the insulation of a wire

insulation
a coating or covering on the conductor with the specific function of withstanding voltage

nominal conductor dimension
the designation of the conductor size in accordance with IEC 60317

winding wire
a wire used for winding a coil to provide a magnetic field

wire
a conductor coated or covered with an insulation

normal vision
20/20 vision, with corrective lenses, if necessary

3.2 General notes on methods of test

All methods of test to be used for this standard are given in IEC 60851.

The clause numbers used in this standard are identical with the respective test numbers of IEC 60851.

In case of inconsistencies between the publication on methods of test and this standard, IEC 60317-0-2 shall prevail.

Where no specific range of nominal conductor dimensions is given for a test, the test applies to all nominal conductor dimensions covered by the specification sheet.

Unless otherwise specified, all tests shall be carried out at a temperature from 15 °C to 35 °C and a relative humidity from 45 % to 75 %. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow the specimens to reach stability.

The wire to be tested shall be removed from the packaging in such a way that the wire will not be subjected to tension or unnecessary bends. Before each test, sufficient wire should be discarded to ensure that any damaged wire is not included in the test specimens.

3.3 Appearance

The film coating shall be essentially smooth and continuous, free from streaks, blisters and foreign material when examined with normal vision, as wound on the original spool or reel.

4 Dimensions

4.1 Conductor dimensions

The dimensions for widths and thickness of conductors of winding wires with rectangular cross-section recommended in this standard are taken from the R 20 and R 40 series according to ISO 3.

Preferred sizes are combinations of width and thickness both according to the R 20 series.

Intermediate sizes are combinations of width or thickness according to the R 20 series with the other dimension according to the R 40 series.

This standard covers:

– widths from 2,00 mm up to and including 16,00 mm;
– thicknesses from 0,80 mm up to and including 5,60 mm.*

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* For thicknesses over 5,60 mm up to and including 10 mm and for widths over 16 mm up to and including 25 mm where, for technical reasons, additional sizes may be needed, the R 40 series shall be used. The ratio width/thickness shall be within the specified limits and combinations of R 40 and R 40 are not allowed in the case of additional sizes.

The ratio width/thickness shall be greater than or equal to 1,4:1 and shall not exceed 8:1.

The actual values of dimensions are given in table 2.**

The nominal cross-sectional areas for preferred sizes are given in table 2, and the nominal cross-sectional areas for intermediate sizes are given in annex A.

4.2 Tolerance on conductor dimensions

The conductor dimensions shall not differ from the nominal values by more than the tolerance given in table 1.

Table 1 – Conductor tolerances

Nominal width or thickness of the conductor mm		Tolerance ±
Over	**Up to and including**	mm
–	3,15	0,030
3,15	6,30	0,050
6,30	12,50	0,070
12,50	16,00	0,100

4.3 Rounding of corners

The arc shall merge smoothly into the flat surfaces of the conductor and the strip shall be free from sharp, rough and projecting edges. The conductor shall have radiused corners complying with table 3. The specified radii shall be maintained within ±25 %.

** Dimensions according to R 20 series are printed in larger type.

Table 2 – Nominal cross-sectional areas of preferred sizes

Thickness →

Width ↓ mm	0,80	0.85	0,90	0.95	1,00	1.06	1,12	1.18	1,25	1.32	1,40	1.50	1,60	1.70	1,80	1.90	2,00	2.12	2,24	2.36	2,50	2.65	2,80	3.00	3,15	3.35	3,55	3.75	4,00	4.25	4,50	4.75	5,00	5.30	5,60
	Corner radius*					Corner radius 0.5 mm								Corner radius 0.65 mm						Corner radius 0.8 mm								Corner radius 1.0 mm							
2,00	1.463		1.626		1.785		2.025		2.285		2.585																								
2.12		—		—		—		—		—		—																							
2,24	1.655		1.842		2.025		2.294		2.585		2.921		3.369																						
2.36		—		—		—		—		—		—		—																					
2,50	1.863		2.076		2.285		2.585		2.910		3.285		3.785		4.137																				
2.65		—		—		—		—		—		—		—		—																			
2,80	2.103		2.346		2.585		2.921		3.285		3.705		4.265		4.677		5.237																		
3.00		—		—		—		—		—		—		—		—		—																	
3,15	2.383		2.661		2.935		3.313		3.723		4.195		4.825		5.307		5.937		6.693																
3.35		—		—		—		—		—		—		—		—		—		—															
3,55	2.703		3.021		3.335		3.761		4.223		4.755		5.465		6.027		6.737		7.589		8.326														
3.75		—		—		—		—		—		—		—		—		—		—		—													
4,00	3.063		3.426		3.785		4.265		4.785		5.385		6.185		6.837		7.637		8.597		9.451		10.65												
4.25		—		—		—		—		—		—		—		—		—		—		—		—											
4,50	3.463		3.876		4.285		4.825		5.410		6.085		6.985		7.737		8.637		9.717		10.70		12.05		13.63										
4.75		—		—		—		—		—		—		—		—		—		—		—		—		—									
5,00	3.863		4.326		4.785		5.385		6.035		6.785		7.785		8.637		9.637		10.84		11.95		13.45		15.20		17.20								
5.30		—		—		—		—		—		—		—		—		—		—		—		—		—		—							
5,60	4.343		4.866		5.385		6.057		6.785		7.625		8.745		9.717		10.84		12.18		13.45		15.13		17.09		19.33		21.54						
6.00		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
6,30	4.903		5.496		6.085		6.841		7.660		8.605		9.865		10.98		12.24		13.75		15.20		17.09		19.30		21.82		24.34		27.49				
6.70		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—			
7,10			6.216		6.885		7.737		8.660		9.725		11.15		12.42		13.84		15.54		17.20		19.33		21.82		24.66		27.54		31.09		34.64		
7.50				—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—
8,00					7.785		8.745		9.785		10.99		12.59		14.04		15.64		17.56		19.45		21.85		24.65		27.85		31.14		35.14		39.14		43.94
8.50						—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—
9,00							9.865		11.04		12.39		14.19		15.84		17.64		19.80		21.95		24.65		27.80		31.40		35.14		39.64		44.14		49.54
9.50								—		—		—		—		—		—		—		—		—		—		—		—		—		—		—
10,0									12.29		13.79		15.79		17.64		19.64		22.04		24.45		27.45		30.95		34.95		39.14		44.14		49.14		55.14
10.6										—		—		—		—		—		—		—		—		—		—		—		—		—		—
11,2											15.47		17.71		19.80		22.04		24.73		27.45		30.81		34.73		39.21		43.94		49.54		55.14		61.86
11.8												—		—		—		—		—		—		—		—		—		—		—		—		—
12,5													19.79		22.14		24.64		27.64		30.70		34.45		38.83		43.83		49.14		55.39		61.64		69.14
13.2														—		—		—		—		—		—		—		—		—		—		—		—
14,0															24.84		27.64		31.00		34.45		38.65		43.55		49.15		55.14		62.14		69.14		77.54
15.0																—		—		—		—		—		—		—		—		—		—		—
16,0																	31.64		35.48		39.45		44.25		49.85		56.25		63.14		71.14		79.14		88.74

Not recommended
Ratio width/thickness smaller than 1.4:1

Not recommended
Ratio width/thickness over 8:1

0.95	Figure from R 40 series
1,00	Figure from R 20 series
1.785	Preferred size R 20 × R 20 Nominal cross-sectional area (mm²)
	Intermediate size R 20 × R 40, R 40 × R 20 Nominal cross-sectional area (See Annex A)
—	Dimension not recommended R 40 × R 40

* 0.5 nominal thickness.

Table 3 – Corner radii

Nominal thickness of conductor mm		Corner radius mm
Over	**Up to and including**	
–	1,00	0,5 nominal thickness
1,00	1,60	0,50*
1,60	2,24	0,65**
2,24	3,55	0,80
3,55	5,60	1,00
NOTE If agreed between purchaser and supplier, the corner radii for wires with a width greater than 4,8 mm may be: * 0,5 nominal thickness ** 0,8 mm		

4.4 Increase in dimensions due to the insulation

The increase in width or thickness due to the insulation shall be as given in table 4.

Table 4 – Increases in dimensions

Grade	Increase in dimensions mm		
	Minimum	**Nominal**	**Maximum**
1	0,06	0,085	0,11
2	0,12	0,145	0,17

4.5 Overall dimensions

4.5.1 Nominal overall dimensions

The nominal overall dimensions shall be calculated as the sum of the nominal bare conductor and the nominal increase in dimension due to the insulation.

4.5.2 Minimum overall dimensions

The minimum overall dimensions shall be calculated as the sum of the minimum bare conductor and the minimum increase in dimension due to the insulation. See also note under 4.5.3.

4.5.3 Maximum overall dimensions

The maximum overall dimensions shall be calculated as the sum of the maximum bare conductor and the maximum increase in dimension due to the insulation.

NOTE When agreed between purchaser and supplier, special tolerances for grade 2 as given in annex B may be used to calculate special maximum and minimum dimensions.

5 Electrical resistance

The resistance of the wire shall be expressed as the d.c. resistance at 20 °C. The method used shall provide an accuracy of 0,5 %.

The maximum value of resistance shall be not greater than the value calculated for the minimum tolerated cross-sectional area of the conductor resulting from the minimum dimensions in thickness and width and the maximum for the corner radius, and with a resistivity of 1/58 Ω mm^2 m^{-1}.

One measurement shall be made.

6 Elongation

The elongation at fracture shall be in accordance with the values given in table 5.

Table 5 – Elongation

Nominal thickness of the conductor mm		Minimum elongation mm
Over	**Up to and including**	
–	2,50	30
2,50	5,60	32

7 Springiness

The wire shall not exceed the maximum springback of 5 degrees.

8 Flexibility and adherence

8.1 Mandrel winding test

The coating shall show no crack after the wire has been bent flatwise and edgewise on a mandrel with a diameter as specified in table 6.

Table 6 – Mandrel winding

Wire bent on		Mandrel diameter
Width	Sizes up to and including 10 mm	4 × width
	Sizes over 10 mm	5 × width
Thickness	All sizes	4 × thickness

8.2 Adherence test

The wire shall be stretched by 15 %. The distance of loss of adhesion shall be less than 1 × width.

9 Heat shock

The coating shall show no crack after the wire has been bent flatwise on a mandrel with a diameter of six times the thickness.

The minimum heat shock temperature is given in the relevant specification sheet.

10 Cut-through

Test under consideration.

11 Resistance to abrasion

Test inappropriate.

12 Resistance to solvents

Standard solvent

Using a pencil of hardness "H" the coating shall not be removed.

13 Breakdown voltage

When tested at room temperature at least four of the five specimens tested shall not break down at a voltage less than or equal to that given in Table 7, and the fifth shall not break down at less than 50 % of the values specified.

When required by the purchaser, the wire shall be tested at elevated temperature.

The elevated temperature is given in the relevant specification sheet.

Table 7 – Breakdown voltage

Grade	Minimum breakdown voltage (r.m.s.) mm	
	Room temperature	Elevated temperature
1	1 000	750
2	2 000	1 500

14 Continuity of insulation

Test inappropriate.

15 Temperature index

The test shall be carried out on a round wire having a nominal conductor diameter of 1,000 mm grade 2, unless otherwise agreed between purchaser and supplier.

When unvarnished specimens are tested in accordance with the method given in IEC 60172, the temperature corresponding to an extrapolated life of 20 000 h shall not be less than the temperature given in the relevant specification sheet and the measured life at the lowest test temperature shall not be less than 5 000 h.

When required by a purchaser, the supplier of the enamelled wire shall supply evidence that the wire meets the requirements for the temperature index.

NOTE 1 The temperature index requirement based on an extrapolated life of 20 000 h relates to enamelled wires tested unvarnished and not as part of an insulation system.

NOTE 2 Temperature in degrees Celsius corresponding to the temperature index is not necessarily that at which it is recommended that the wire be operated and this will depend on many factors, including the type of equipment involved.

16 Resistance to refrigerants

Test inappropriate.

17 Solderability

Test inappropriate.

18 Heat or solvent bonding

Test inappropriate.

19 Dielectric dissipation factor

For requirements see the relevant specification sheet.

20 Resistance to transformer oil

For requirements, see the relevant specification sheet.

21 Loss of mass

Test inappropriate.

23 Pin-hole test

Test inappropriate.

30 Packaging

The kind of packaging may influence certain properties of the wire, for example springback. Therefore the kind of packaging for example, the type of spool, shall be agreed between purchaser and supplier.

The wire shall be evenly and compactly wound on spools or placed in containers. No spool or container shall contain more than one length of wire unless agreed to by purchaser and supplier. Marking of the label when there is more than one length and/or identification of the separate lengths in the package, shall be agreed to by purchaser and supplier.

Where wires are delivered in coils, the dimensions and the maximum weights of such coils shall be agreed between purchaser and supplier. Any additional protection for coils shall also be agreed between purchaser and supplier.

Labels shall be attached to each packaging unit as agreed between supplier and user and shall include the following information:

a) manufacturer's name and/or trade mark;

b) type of wire and insulation, for instance trade name and/or IEC specification number;

c) net mass of wire;

d) nominal dimension(s) of wire and grade of insulation;

e) date of manufacture.

Annex A

[illegible]

Nominal cross-sectional areas for preferred and intermediate sizes

Table A.1 – Nominal cross-sectional areas

Nominal width [illegible]	Nominal thickness [illegible]	Radius on corners [illegible]	Nominal cross-section area [illegible]	Nominal width [illegible]	Nominal thickness [illegible]	Radius on corners [illegible]	Nominal cross-section area [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Table A.1 *(continued)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
3,15	0,90	*	2,661
	0,95	*	2,799
	1,00	*	2,935
	1,06	0,5	3,124
	1,12	0,5	3,313
	1,18	0,5	3,502
	1,25	0,5	3,723
	1,32	0,5	3,943
	1,40	0,5	4,195
	1,50	0,5	4,510
	1,60	0,5	4,825
	1,70	0,65	4,992
	1,80	0,65	5,307
	1,90	0,65	5,622
	2,00	0,65	5,937
	2,12	0,65	6,315
	2,24	0,65	6,693
3,35	0,80	*	2,543
	0,90	*	2,841
	1,00	*	3,135
	1,12	0,5	3,537
	1,25	0,5	3,973
	1,40	0,5	4,475
	1,60	0,5	5,145
	1,80	0,65	5,667
	2,00	0,65	6,337
	2,24	0,65	7,141
3,55	0,80	*	2,703
	0,85	*	2,862
	0,90	*	3,021
	0,95	*	3,179
	1,00	*	3,335
	1,06	0,5	3,548
	1,12	0,5	3,761
	1,18	0,5	3,974
	1,25	0,5	4,223
	1,32	0,5	4,471
	1,40	0,5	4,755
	1,50	0,5	5,110
	1,60	0,5	5,465
	1,70	0,65	5,672
	1,80	0,65	6,027
	1,90	0,65	6,382
	2,00	0,65	6,737
	2,12	0,65	7,163
	2,24	0,65	7,589
	2,36	0,8	7,829
	2,50	0,8	8,326
3,75	0,80	*	2,863
	0,90	*	3,201
	1,00	*	3,535
	1,12	0,5	3,985
	1,25	0,5	4,473
	1,40	0,5	5,035
	1,60	0,5	5,785
	1,80	0,65	6,387
	2,00	0,65	7,137
	2,24	0,65	8,037
	2,50	0,8	8,826
4,00	0,80	*	3,063
	0,85	*	3,245
	0,90	*	3,426
	0,95	*	3,606
	1,00	*	3,785
	1,06	0,5	4,025
	1,12	0,5	4,265
	1,18	0,5	4,505
	1,25	0,5	4,785
	1,32	0,5	5,065
	1,40	0,5	5,385
	1,50	0,5	5,785
	1,60	0,5	6,185
	1,70	0,65	6,437
	1,80	0,65	6,837
	1,90	0,65	7,237
	2,00	0,65	7,637
	2,12	0,65	8,117
	2,24	0,65	8,597
	2,36	0,8	8,891
	2,50	0,8	9,451
	2,65	0,8	10,05
	2,80	0,8	10,65
4,25	0,80	*	3,263
	0,90	*	3,651
	1,00	*	4,035
	1,12	0,5	4,545
	1,25	0,5	5,098
	1,40	0,5	5,735
	1,60	0,5	6,585
	1,80	0,65	7,287
	2,00	0,65	8,137
	2,24	0,65	9,157
	2,50	0,8	10,08
	2,80	0,8	11,35

* 0,5 nominal thickness.

Table A.1 *(continued)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
4,50	0,80	*	3,463
	0,85	*	3,670
	0,90	*	3,876
	0,95	*	4,081
	1,00	*	4,285
	1,06	0,5	4,555
	1,12	0,5	4,825
	1,18	0,5	5,095
	1,25	0,5	5,410
	1,32	0,5	5,725
	1,40	0,5	6,085
	1,50	0,5	6,535
	1,60	0,5	6,985
	1,70	0,65	7,287
	1,80	0,65	7,737
	1,90	0,65	8,187
	2,00	0,65	8,637
	2,12	0,65	9,177
	2,24	0,65	9,717
	2,36	0,8	10,07
	2,50	0,8	10,70
	2,65	0,8	11,38
	2,80	0,8	12,05
	3,00	0,8	12,95
	3,15	0,8	13,63
4,75	0,80	*	3,663
	0,90	*	4,101
	1,00	*	4,535
	1,12	0,5	5,105
	1,25	0,5	5,723
	1,40	0,5	6,435
	1,60	0,5	7,385
	1,80	0,65	8,188
	2,00	0,65	9,137
	2,24	0,65	10,28
	2,50	0,8	11,33
	2,80	0,8	12,75
	3,15	0,8	14,41
5,00	0,80	*	3,863
	0,85	*	4,095
	0,90	*	4,326
	0,95	*	4,556
	1,00	*	4,785
	1,06	0,5	5,085
	1,12	0,5	5,385
	1,18	0,5	5,685
	1,25	0,5	6,035
	1,32	0,5	6,385
	1,40	0,5	6,785
	1,50	0,5	7,285
	1,60	0,5	7,785
5,00	1,70	0,65	8,137
	1,80	0,65	8,637
	1,90	0,65	9,137
	2,00	0,65	9,637
	2,12	0,65	10,24
	2,24	0,65	10,84
	2,36	0,8	11,25
	2,50	0,8	11,95
	2,65	0,8	12,70
	2,80	0,8	13,45
	3,00	0,8	14,45
	3,15	0,8	15,20
	3,35	0,8	16,20
	3,55	0,8	17,20
5,30	0,80	*	4,103
	0,90	*	4,596
	1,00	*	5,085
	1,12	0,5	5,721
	1,25	0,5	6,410
	1,40	0,5	7,205
	1,60	0,5	8,265
	1,80	0,65	9,177
	2,00	0,65	10,24
	2,24	0,65	11,51
	2,50	0,8	12,70
	2,80	0,8	14,29
	3,15	0,8	16,15
	3,55	0,8	18,27
5,60	0,80	*	4,343
	0,85	*	4,605
	0,90	*	4,866
	0,95	*	5,126
	1,00	*	5,385
	1,06	0,5	5,721
	1,12	0,5	6,057
	1,18	0,5	6,393
	1,25	0,5	6,785
	1,32	0,5	7,177
	1,40	0,5	7,625
	1,50	0,5	8,185
	1,60	0,5	8,745
	1,70	0,65	9,157
	1,80	0,65	9,717
	1,90	0,65	10,28
	2,00	0,65	10,84
	2,12	0,65	11,51
	2,24	0,65	12,18
	2,36	0,8	12,67
	2,50	0,8	13,45
	2,65	0,8	14,29
	2,80	0,8	15,13

* 0,5 nominal thickness.

Table A.1 *(continued)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
5,60	3,00	0,8	16,25
	3,15	0,8	17,09
	3,35	0,8	18,21
	3,55	0,8	19,33
	3,75	1,0	20,14
	4,00	1,0	21,54
6,00	0,80	*	4,663
	0,90	*	5,226
	1,00	*	5,785
	1,12	0,5	6,505
	1,25	0,5	7,285
	1,40	0,5	8,185
	1,60	0,5	9,385
	1,80	0,65	10,44
	2,00	0,65	11,64
	2,24	0,65	13,08
	2,50	0,8	14,45
	2,80	0,8	16,25
	3,15	0,8	18,35
	3,55	0,8	20,75
	4,00	1,0	23,14
6,30	0,80	*	4,903
	0,85	*	5,200
	0,90	*	5,496
	0,95	*	5,791
	1,00	*	6,085
	1,06	0,5	6,463
	1,12	0,5	6,841
	1,18	0,5	7,219
	1,25	0,5	7,660
	1,32	0,5	8,101
	1,40	0,5	8,605
	1,50	0,5	9,235
	1,60	0,5	9,865
	1,70	0,65	10,35
	1,80	0,65	10,98
	1,90	0,65	11,61
	2,00	0,65	12,24
	2,12	0,65	12,99
	2,24	0,65	13,75
	2,36	0,8	14,32
	2,50	0,8	15,20
	2,65	0,8	16,15
	2,80	0,8	17,09
	3,00	0,8	18,35
	3,15	0,8	19,30
	3,35	0,8	20,56
	3,55	0,8	21,82
6,30	3,75	1,0	22,77
	4,00	1,0	24,34
	4,25	1,0	25,92
	4,50	1,0	27,49
6,70	0,90	*	5,856
	1,00	*	6,485
	1,12	0,5	7,289
	1,25	0,5	8,160
	1,40	0,5	9,165
	1,60	0,5	10,51
	1,80	0,65	11,70
	2,00	0,65	13,04
	2,24	0,65	14,65
	2,50	0,8	16,20
	2,80	0,8	28,21
	3,15	0,8	20,56
	3,55	0,8	23,24
	4,00	1,0	25,94
	4,50	1,0	29,29
7,10	0,90	*	6,216
	0,95	*	6,551
	1,00	*	6,885
	1,06	0,5	7,311
	1,12	0,5	7,737
	1,18	0,5	8,163
	1,25	0,5	8,660
	1,32	0,5	9,157
	1,40	0,5	9,725
	1,50	0,5	10,44
	1,60	0,5	11,15
	1,70	0,65	11,71
	1,80	0,65	12,42
	1,90	0,65	13,13
	2,00	0,65	13,84
	2,12	0,65	14,69
	2,24	0,65	15,54
	2,36	0,8	16,21
	2,50	0,8	17,20
	2,65	0,8	18,27
	2,80	0,8	19,33
	3,00	0,8	20,75
	3,15	0,8	21,82
	3,35	0,8	23,24
	3,55	0,8	24,66
	3,75	1,0	25,77
	4,00	1,0	27,54
	4,25	1,0	29,32

* 0,5 nominal thickness.

Table A.1 *(continued)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
7,10	4,50	1,0	31,09
	4,75	1,0	32,87
	5,00	1,0	34,64
7,50	1,00	*	7,285
	1,12	0,5	8,185
	1,25	0,5	9,160
	1,40	0,5	10,29
	1,60	0,5	11,79
	1,80	0,65	13,14
	2,00	0,65	14,64
	2,24	0,65	16,44
	2,50	0,8	18,20
	2,80	0,8	20,45
	3,15	0,8	23,08
	3,55	0,8	26,08
	4,00	1,0	29,14
	4,50	1,0	32,89
	5,00	1,0	36,64
8,00	1,00	*	7,785
	1,06	0,5	8,265
	1,12	0,5	8,745
	1,18	0,5	9,225
	1,25	0,5	9,785
	1,32	0,5	10,35
	1,40	0,5	10,99
	1,50	0,5	11,79
	1,60	0,5	12,59
	1,70	0,65	13,24
	1,80	0,65	14,04
	1,90	0,65	14,84
	2,00	0,65	15,64
	2,12	0,65	16,60
	2,24	0,65	17,56
	2,36	0,8	18,33
	2,50	0,8	19,45
	2,65	0,8	20,65
	2,80	0,8	21,85
	3,00	0,8	23,45
	3,15	0,8	24,65
	3,35	0,8	26,25
	3,55	0,8	27,85
	3,75	1,0	29,14
	4,00	1,0	31,14
	4,25	1,0	33,14
	4,50	1,0	35,14
	4,75	1,0	37,14
	5,00	1,0	39,14
	5,30	1,0	41,54
	5,60	1,0	43,94

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
8,50	1,12	0,5	9,305
	1,25	0,5	10,41
	1,40	0,5	11,69
	1,60	0,5	13,39
	1,80	0,65	14,94
	2,00	0,65	16,64
	2,24	0,65	18,68
	2,50	0,8	20,70
	2,80	0,8	23,25
	3,15	0,8	26,23
	3,55	0,8	29,63
	4,00	1,0	33,14
	4,50	1,0	37,39
	5,00	1,0	41,64
	5,60	1,0	46,74
9,00	1,12	0,5	9,865
	1,18	0,5	10,41
	1,25	0,5	11,04
	1,32	0,5	11,67
	1,40	0,5	12,39
	1,50	0,5	13,29
	1,60	0,5	14,19
	1,70	0,65	14,94
	1,80	0,65	15,84
	1,90	0,65	16,74
	2,00	0,65	17,64
	2,12	0,65	18,72
	2,24	0,65	19,80
	2,36	0,8	20,69
	2,50	0,8	21,95
	2,65	0,8	23,30
	2,80	0,8	24,65
	3,00	0,8	26,45
	3,15	0,8	27,80
	3,35	0,8	29,60
	3,55	0,8	31,40
	3,75	1,0	32,89
	4,00	1,0	35,14
	4,25	1,0	37,39
	4,50	1,0	39,64
	4,75	1,0	41,89
	5,00	1,0	44,14
	5,30	1,0	46,84
	5,60	1,0	49,54
9,50	1,25	0,5	11,66
	1,40	0,5	13,09
	1,60	0,5	14,99
	1,80	0,65	16,74
	2,00	0,65	18,64
	2,24	0,65	20,92

* 0,5 nominal thickness.

Table A.1 *(continued)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
9,50	2,50	0,8	23,20
	2,80	0,8	26,05
	3,15	0,8	29,38
	3,55	0,8	33,18
	4,00	1,0	37,14
	4,50	1,0	41,89
	5,00	1,0	46,64
	5,60	1,0	52,34
10,00	1,25	0,5	12,29
	1,32	0,5	12,99
	1,40	0,5	13,79
	1,50	0,5	14,79
	1,60	0,5	15,79
	1,70	0,65	16,64
	1,80	0,65	17,64
	1,90	0,65	18,64
	2,00	0,65	19,64
	2,12	0,65	20,84
	2,24	0,65	22,04
	2,36	0,8	23,05
	2,50	0,8	24,45
	2,65	0,8	25,95
	2,80	0,8	27,45
	3,00	0,8	29,45
	3,15	0,8	30,95
	3,35	0,8	32,95
	3,55	0,8	34,95
	3,75	1,0	36,64
	4,00	1,0	39,14
	4,25	1,0	41,64
	4,50	1,0	44,14
	4,75	1,0	46,64
	5,00	1,0	49,14
	5,30	1,0	52,14
	5,60	1,0	55,14
10,60	1,40	0,5	14,63
	1,60	0,5	16,75
	1,80	0,65	18,72
	2,00	0,65	20,84
	2,24	0,65	23,38
	2,50	0,8	25,95
	2,80	0,8	29,13
	3,15	0,8	32,84
	3,55	0,8	37,08
	4,00	1,0	41,54
	4,50	1,0	46,84
	5,00	1,0	52,14
	5,60	1,0	58,50
11,20	1,40	0,5	15,47
	1,50	0,5	16,59
	1,60	0,5	17,71

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
11,20	1,70	0,65	18,68
	1,80	0,65	19,80
	1,90	0,65	20,92
	2,00	0,65	22,04
	2,12	0,65	23,38
	2,24	0,65	24,73
	2,36	0,8	25,88
	2,50	0,8	27,45
	2,65	0,8	29,13
	2,80	0,8	30,81
	3,00	0,8	33,05
	3,15	0,8	34,73
	3,35	0,8	36,97
	3,55	0,8	39,21
	3,75	1,0	41,14
	4,00	1,0	43,94
	4,25	1,0	46,74
	4,50	1,0	49,54
	4,75	1,0	52,34
	5,00	1,0	55,14
	5,30	1,0	58,50
	5,60	1,0	61,86
11,80	1,60	0,5	18,67
	1,80	0,65	20,88
	2,00	0,65	23,24
	2,24	0,65	26,07
	2,50	0,8	28,95
	2,80	0,8	32,49
	3,15	0,8	36,62
	3,55	0,8	41,34
	4,00	1,0	46,34
	4,50	1,0	52,24
	5,00	1,0	58,14
	5,60	1,0	65,22
12,50	1,60	0,5	19,79
	1,70	0,65	20,89
	1,80	0,65	22,14
	1,90	0,65	23,39
	2,00	0,65	24,64
	2,12	0,65	26,14
	2,24	0,65	27,64
	2,36	0,8	28,95
	2,50	0,8	30,70
	2,65	0,8	32,58
	2,80	0,8	34,45
	3,00	0,8	36,95
	3,15	0,8	38,83
	3,35	0,8	41,33
	3,55	0,8	43,83
	3,75	1,0	46,02
	4,00	1,0	49,14
	4,25	1,0	52,27

Table A.1 *(concluded)*

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
12,50	4,50	1,0	55,39
	4,75	1,0	58,52
	5,00	1,0	61,64
	5,30	1,0	65,39
	5,60	1,0	69,14
13,20	1,80	0,65	23,40
	2,00	0,65	26,04
	2,24	0,65	29,21
	2,50	0,8	32,45
	2,80	0,8	36,41
	3,15	0,8	41,03
	3,55	0,8	46,31
	4,00	1,0	51,94
	4,50	1,0	58,54
	5,00	1,0	65,14
	5,60	1,0	73,06
14,00	1,80	0,65	24,84
	1,90	0,65	26,24
	2,00	0,65	27,64
	2,12	0,65	29,32
	2,24	0,65	31,00
	2,36	0,8	32,49
	2,50	0,8	34,45
	2,65	0,8	36,55
	2,80	0,8	38,65
	3,00	0,8	41,45
	3,15	0,8	43,55
	3,35	0,8	46,35
	3,55	0,8	49,15
	3,75	1,0	51,64
	4,00	1,0	55,14
	4,25	1,0	58,64
	4,50	1,0	62,14

Nominal width mm	Nominal thickness mm	Radius on corners mm	Nominal cross-section area mm²
14,00	4,75	1,0	65,64
	5,00	1,0	69,14
	5,30	1,0	73,34
	5,60	1,0	77,54
15,00	2,00	0,65	29,64
	2,24	0,65	33,24
	2,50	0,8	36,95
	2,80	0,8	41,45
	3,15	0,8	46,70
	3,55	0,8	52,70
	4,00	1,0	59,14
	4,50	1,0	66,64
	5,00	1,0	74,14
	5,60	1,0	83,14
16,00	2,00	0,65	31,64
	2,12	0,65	33,56
	2,24	0,65	35,48
	2,36	0,8	37,21
	2,50	0,8	39,45
	2,65	0,8	41,85
	2,80	0,8	44,25
	3,00	0,8	47,45
	3,15	0,8	49,85
	3,35	0,8	53,05
	3,55	0,8	56,25
	3,75	1,0	59,14
	4,00	1,0	63,14
	4,25	1,0	67,14
	4,50	1,0	71,14
	4,75	1,0	75,14
	5,00	1,0	79,14
	5,30	1,0	83,94
	5,60	1,0	88,74

Annex B
(informative)

Special tolerances

Nominal width or thickness of the conductor mm		Tolerances on nominal overall dimensions for grade 2 ± mm	
Over	**Up to and including**	**Width**	**Thickness**
–	2,00	–	0,03
2,00	3,15	0,06	0,03
3,15	5,60	0,06	0,05
5,60	6,30	0,06	–
6,30	12,50	0,08	–
12,50	16,00	0,10	–

Annex E
(informative)

High temperature failure test

No requirements are specified.

For test method see annex A of IEC 60851-6.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60851 (All parts) Methods of test for winding wires	IS 13778 (Part 1) Methods of test for winding wires: Part 1 General (*first revision)* (*under print*)	Identical with IEC 60851-1 : 1996
	IS 13778 (Part 2) Methods of test for winding wires: Part 2 Determination of dimensions (*under print*)	Identical with IEC 60851-2 : 1985
	IS 13778 (Part 3) Methods of test for winding wires: Part 3 Mechanical properties (*under print*)	Identical with IEC 60851-3 : 1985
	IS 13778 (Part 4) Methods of test for winding wires: Part 4 Chemical properties (*first revision*) (*under print*)	Identical with IEC 60851-4 : 2005
	IS 13778 (Part 5) Methods of test for winding wires: Part 5 Electrical properties (*under print*)	Identical with IEC 60851-5 : 1985
	IS 13778 (Part 6) Methods of test for winding wires: Part 6 Thermal properties (*first revision*) (*under print*)	Identical with IEC 60851-6 : 1996
ISO 3 : 1973 Preferred numbers — Series of preferred numbers	IS 1076 (Part 1) : 1985 Preferred numbers: Part 1 Series of preferred numbers (*second revision*)	Identical

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC 60317-18	Specifications for particular types of winding wires — Part 18: Polyvinyl acetal enamelled rectangular copper wire, class 120
IEC 60317-30	Specifications for particular types of winding wires — Part 30: Polyimide enamelled rectangular copper wire, class 220

Only the English language text has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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